

EXHIBIT 3

Expert Report of Dr. Jean-Pierre Dubé

September 17, 2015

I. Scope of Report

1. I have been engaged as an expert by Plaintiffs' counsel, Finkelstein, Blankinship, Frei-Pearson & Garber, LLP. I provide this report in connection with the case filed by Plaintiffs against Defendant, Johnson & Johnson Consumer Companies Inc. (J&J). I have been advised by counsel for Plaintiffs that individuals purchased certain J&J Aveeno brand products which were labeled as "Active Naturals." I have been further advised that Plaintiffs allege that this claim is false, misleading, and/or deceptive to a reasonable consumer and therefore should not have been made. I have been asked by counsel for plaintiffs to assess whether it is possible to determine economic damages in this case on a classwide basis using common evidence, and if so, to provide a framework for an assessment of damages suffered by the classes of plaintiffs resulting from the allegedly false, misleading, and/or deceptive "Active Naturals" claim.
2. It is my opinion that it is possible to determine classwide damages in this case using Conjoint Analysis and Random Coefficients Demand Estimation. I can provide an expert opinion regarding the following matters:
 - i) The existence of methodologies that can measure and quantify the impact of the "Active Naturals" claim on the packaging of Aveeno products on consumer willingness-to-pay and Aveeno product prices.
 - ii) A description of these methodologies and their implementation, given the existence of such methodologies and suitable data, the feasibility of measuring (a) the incremental consumer willingness-to-pay for Aveeno products due to the "Active Naturals" claim; and (b) the price premium charged for Aveeno products due to the "Active Naturals" claim.
3. My opinions in this report are based on my own experience and training as well as the materials that I have reviewed, as summarized in Appendix B. The Plaintiffs are

compensating me for my time at my standard hourly rate of \$850, plus direct costs. My compensation is not dependent on the opinions I express or on the outcome of the case.

II. Professional Qualifications

4. I am the Sigmund E. Edelstone Professor of Marketing at the University of Chicago Booth School of Business. I received my B.Sc. in quantitative methods in economics with a minor in French literature from the University of Toronto in 1995. In 2000, I completed my Ph.D. in Economics at Northwestern.
5. I have been on faculty at the University of Chicago Booth School of Business since 2000. During this time, I have served as the area advisor for Ph.D. students in marketing and as the coordinator of the MBA courses in marketing. I have also recently been appointed as the director of the Booth School's *Kilts Center for Marketing* which, amongst other functions, serves as the official distributor of Nielsen's Consumer Packaged Goods (hereafter CPG) databases for academic usage worldwide.
6. During the course of my fifteen-year career, I have taught MBA and executive courses at the University of Chicago on digital marketing strategies, pricing strategies, category management for retailers and marketing analytics. I also teach a Ph.D.-level course on quantitative marketing. Several of these courses cover frameworks for modeling and empirically measuring consumer willingness-to-pay and the impact on firm pricing. In addition, several of these courses cover Conjoint Analysis and Random Coefficients Demand Estimation.
7. I have published thirty-two articles, mostly in the leading marketing and economics journals. Several of these papers have been nominated for and won awards for best paper. I currently serve as an Area/Associate Editor for the four leading quantitative marketing journals. I have also been appointed as a Faculty Research Fellow at the National Bureau of Economic Research since 2009.
8. My research typically uses state-of-the-art theory and methods from the domains of quantitative marketing, industrial organization, econometrics and statistics. Several of my

papers analyze consumer choice data from the CPG industry in the US to measure and quantify consumer preferences and consumer decision-making. A recurrent theme in this work is the role of product differentiation and brands on consumer demand for CPG brands. Many of these papers have studied the normative implications for CPG firms' pricing and advertising strategies. A standard approach for deriving such normative implications consists of using models estimated with consumer data to conduct counterfactual analyses.

9. Some of my recent research has focused specifically on the impact of consumer information on the demand for branded CPG products. This year, I published a co-authored paper studying the role of objective consumer information on the willingness-to-pay a price premium for branded versus private label CPG products. This work has been covered by the popular press including the *Wall Street Journal*, *Slate Magazine* and NPR radio. In follow-up research in progress, I recently conducted a field study in a Chicago-area supermarket chain to test the impact of information on consumers' purchase behavior for various CPG food products.
10. In another stream of published work, I have developed methodologies for estimating and quantifying consumer demand. In one paper, I developed a new econometric algorithm for Random Coefficients Demand Estimation that was published in *Econometrica*, a leading general-interest academic journal in Economics. I subsequently developed a corresponding computer code library which is now being used by the European Commission to conduct Random Coefficients Demand Estimation for European merger and antitrust cases in the CPG industry. In another published paper, I developed a new method for Conjoint Analysis that accommodates consumers' expectations about future prices (i.e. "price information") into predicted purchase behavior.
11. I have worked as an expert witness on several cases related to branding and trademark/copyright issues. I have also worked on cases related to the impact of imagery and information on product packaging on pricing and other market outcomes. Several of these cases have required me to conduct counterfactual analyses that are

methodologically similar to those that can be used in the current case. In one case, I testified as an expert witness in a deposition.

12. Within the last four years, I served as an expert witness for the plaintiffs in the case American Institute of Physics, John Wiley & Sons, Inc., and Wiley Periodicals, Inc., Plaintiffs,
v.
Schwegman Lundberg & Woessner, P.A., and John Doe Nos. 1-10. Defendants,
v.
The United States Patent and Trademark Office, Intervenor Defendant.

CIV. No. 12-528 (RHK/JJK).
United States District Court, D. Minnesota.
July 30, 2013.

My final report for this case was submitted on December 17, 2012, and a supplement to the report was submitted on March 13, 2013.

13. I have also frequently consulted with firms in a variety of industries that include consumer goods, professional services, digital media, high technology, software and healthcare. In several of these engagements, I have used Conjoint Analysis and Random Coefficients Demand Estimation.

14. Additional qualifications are listed in my Curriculum Vitae attached as Appendix A. Attached as Appendix B is a summary of documents and information I have considered in forming my opinions in this report.

III. Summary of Expert Opinions

15. For the reasons discussed in my report, I have reached the following conclusions:

- i) It is my opinion that methodologies exist with which one can evaluate the impact of the placement of “Active Naturals” on Aveeno product packaging on consumer willingness-to-pay, product prices and other market outcomes. In particular, the combination of Random Coefficients Demand Estimation and appropriate Conjoint Analysis can ascertain these effects.
- ii) The measurements obtained from these two methods can be used to evaluate (i) consumer willingness-to-pay for Aveeno products but-for the placement of

“Active Naturals” on the product packaging; and (ii) the equilibrium prices charged for Aveeno products but-for the placement of “Active Naturals” on their packaging.

IV. Methodologies for Quantifying the Impact of Placing “Active Naturals” on Aveeno Labels on Consumer Willingness-to-pay

A. The Characteristics Approach

16. The Characteristics Approach is the standard conceptual model used to evaluate the economic value to a consumer from a product feature or attribute. Hereafter, I will refer to product features and attributes broadly as characteristics. The term “Characteristics Approach” is used to denote the assumption that consumers perceive products as an underlying bundle of characteristics that constitute the product. A consumer obtains marginal utility (or a “part-worth”) from each of the underlying characteristics. The total utility (or “total worth”) from the product is the sum of the marginal utilities from each of the underlying characteristics, net of the price paid.
17. In practice, consumers are confronted with choice sets consisting of multiple product alternatives. Under the Characteristics Approach, the consumer is assumed to evaluate each product alternative based on its underlying bundle of characteristics. A microeconomic application of the Characteristics Approach assumes the consumer ultimately chooses the product from which she obtains the highest total utility. Often, the “no-purchase” alternative is included in the choice set. The no-purchase alternative is often defined as a bundle for which all the characteristics and the price have been set to 0.
18. The economic value to the consumer of a given product is then measured as the consumer’s maximum willingness-to-pay (hereafter WTP) for the underlying bundle of characteristics that constitute the product in question, given the consumer’s choice set. If marginal utilities for product characteristics are known, the analyst can compute WTP. A consumer’s objective WTP for a product equals the difference in the expected dollar value she obtains from choosing the utility-maximizing alternative from a choice set that

includes the product in question, and from a choice set that excludes the product in question. Everything else about the choice set is held fixed. WTP can be interpreted equivalently as the expected dollar amount that would need to be paid to the consumer to ensure she obtains the same utility from a choice set that excludes the product in question as she did from the choice set that includes the product in question. In general, WTP is measured by comparing the consumer's value when offered the factual choice set to her value when offered some correctly defined counterfactual choice set.

19. An analogous approach is used to evaluate a consumer's WTP for a specific product feature (Allenby, Brazell, Howell, and Rossi 2014). Consumer WTP for the "Active Naturals" claim (hereafter ANC) on Aveeno packaging is computed by comparing the expected consumer value in dollars from offering the consumer the following two choice sets respectively:
 - i) The factual choice set (A): this choice set includes all the available products including Aveeno with the ANC on the packaging.
 - ii) The counterfactual choice set (B): this choice set is identical to A except that the ANC is removed from all the Aveeno packaging.WTP for the ANC consists of computing the dollar amount the consumer would need to be paid to be as well off with the counterfactual choice set B as she was with the factual choice set A.
20. WTP in paragraph 19 considers only the demand side of the market. On the supply side, the change in consumer demand but-for the ANC on Aveeno's packaging could likely change Aveeno's and its competitors' respective pricing incentives. Thus, in addition to the removal of the ANC, the counterfactual used to assess damages should also consider the change in equilibrium prices charged (see for instance Allenby, Brazell, Howell, and Rossi 2014). In this case, the analyst would need to adjust the counterfactual choice sets as follows:
 - i) The counterfactual choice set (B'): this choice set is identical to A except that the ANC is removed from all the Aveeno packaging. In addition, all firms now set the equilibrium prices for their products that correspond to this new choice set.

Now WTP for the ANC consists of computing the dollar amount the consumer would need to be paid to be as well off with the counterfactual choice set B' as she was with the factual choice set A. In this manner, WTP captures both the removal of the claim, on the demand side of the market, and the corresponding readjustment of prices by firms, on the supply side of the market.

21. The measures of WTP in paragraphs 19 and 20 generate two approaches for measuring the damages to consumers from the use of the ANC on Aveeno packaging. The first measure, in paragraph 19, captures only the demand side of the market. The second measure, in paragraph 20, captures both the demand and supply sides of the market. In both cases, damages consist of the expected incremental WTP created by the use of the ANC on Aveeno packaging.

B. Empirical Methodologies for Implementing the Characteristics Approach

22. In order to implement the Characteristics Approach described in paragraphs 16 to 21, the analyst must first estimate the marginal utility a consumer derives from each of the underlying product characteristics. Furthermore, to evaluate any counterfactual changes in equilibrium prices, on the supply side of the market, the analyst must also know firms' unit costs. I will discuss two methods that can be used jointly for the purposes of (i) estimating the marginal utilities of each product characteristic; and (ii) measuring firms' unit costs for each of the products in the analysis.

B.1 Random Coefficients Demand Estimation

23. Random Coefficients Demand Estimation (hereafter RCDE) is an established econometric methodology that can be used to estimate the marginal utility of product characteristics and consumer price sensitivity when appropriate data are available. The RCDE method is used frequently in merger and antitrust trials for which market share, price and product feature data are available for the relevant products. The classic reference for the method and its application to data is:

“Automobile Prices in Market Equilibrium,” by Steven Berry, James Levinsohn and Ariel Pakes, *Econometrica*, Vol. 63, No. 4. (Jul., 1995), pp. 841-890.

A user manual for the method was published in:

“A Practitioner’s Guide to Estimation of Random-Coefficients Logit Models of Demand” by Aviv Nevo, *Journal of Economics & Management Strategy*, Volume 9, Number 4, Winter 2000, 513–548.

More recently, an improved and more reliable algorithm for implementing the method, of which I was a co-author, was published in:

“Improving the Numerical Performance of BLP Static and Dynamic Discrete Choice Random Coefficients Demand Estimation,” by Jean-Pierre Dubé, Jeremy Fox and Che-Lin Su, *Econometrica*, Vol. 80, No. 5. (September 2012).

24. The RCDE methodology is based on the Characteristics Approach. Consumers are assumed to obtain marginal utility from product characteristics. Furthermore, consumers ultimately choose the alternative (either one of the products or the no-purchase alternative) that gives the highest total utility, which is net of the price paid.
25. The estimation methodology proceeds as follows
 - i) Construct a model of the consumer’s utility function that captures the value of the product as a function of its observed characteristics and its price, along with the parameters to be estimated.
 - ii) Include “random coefficients” to allow for the possibility that different consumers value the characteristics and the price differently. In practice, the most popular approach consists of assuming this “heterogeneity in consumer utility for characteristics” follows a Normal distribution with unknown parameters that are to be estimated.

- iii) All other factors influencing a consumer's total utility from a product that are not observed to the analyst are captured by a stochastic component, or "random utility" term. Typically, this component is assumed to be independently and identically distributed type I extreme value.
- iv) It is also possible, if needed, to control for additional factors affecting consumers' perceptions of the product that may be observed to firms but unobserved to the analyst. It is possible to modify the estimation approach accordingly.
- v) Following the aforementioned steps, the probability of a purchase is evaluated by integrating out all stochastic elements. The assumptions in steps (i)-(iv) give rise to the "Random Coefficients Logit" model.
- vi) Aggregating these probabilities across individuals gives a prediction of each product's market share. The predicted market shares are then matched to the observed data.
- vii) A Generalized Method of Moments (hereafter GMM) estimator can be used to obtain statistical estimates of the model parameters. The method requires the analyst to specify several moment conditions for the model. A moment condition is just a function of the model parameters and the data that has an expected value of zero at the true model parameter values. GMM estimation consists of using a search algorithm to choose parameter values that set the sample analog of these moments as close to zero as possible.

26. The approach outlined in steps (i)-(vii) above generates consistent estimates of the model parameters. A formal derivation of the GMM estimator is presented in Appendix C.2. Once these parameters are known, the analyst can use them to measure consumers' marginal utilities from product characteristics. The analyst can, in turn, predict demand for each of the alternatives.

27. It is my understanding that the Aveeno products at issue have always included the “Active Naturals” claim on their packaging. Therefore, the RCDE applied to appropriate data will estimate the consumers’ marginal utilities from the entire bundle of characteristics associated with each product. The Conjoint Analysis, described in paragraphs 29 to 36 below, will be used to decouple the effect of the brand name and the ANC.

B.2 Estimating Firms’ Unit Costs

28. Once the marginal utilities are estimated via RCDE, the analyst can predict demand for each of the products under analysis. If the analyst does not have access to measures of firms’ unit costs, it is possible to infer the unit cost associated with each product. The analyst must make an assumption about the firms’ conduct that led to the prices that are observed in the data. Typically, the analyst assumes that each firm sets prices to maximize its total profitability (e.g. Berry, Levinson and Pakes 1995). Appendix C.3 shows how this assumption can be combined with the demand estimates from RCDE to obtain estimates of each product’s unit cost.

C. Conjoint Analysis

29. Conjoint Analysis can be used to decompose the utility from an Aveeno product into a marginal utility from the brand name and a marginal utility from the ANC. Conjoint Analysis, another popular approach used to estimate consumers’ marginal utilities corresponding to the Characteristics Approach, consists of a type of survey that has been used extensively in marketing research for decades (e.g. Green and Srinivasan 1990). The term “Conjoint Analysis” derives from the phrase “consider jointly.”

30. Conjoint Analysis works similarly to the RCDE approach in the sense that both methods use the Characteristics Approach described in section B above and both assume that consumer choices are based on utility maximization. However, Conjoint Analysis uses a different data format. The data are collected through surveys conducted with consumers as opposed to actual historical purchase data. In addition, the survey data consist of

individual-level responses as opposed to product-level market shares. Accordingly, the method used to analyze the conjoint survey data is also different from the GMM estimator used in the RCDE approach.

31. Choice-based Conjoint Analysis proceeds by asking consumers to respond to a sequence of choice tasks. In each task, the consumer is presented with a choice between a finite number of product alternatives. Each alternative is described by a set of characteristics chosen by the analyst, including the price. Often, a no-purchase alternative is included in the choice set. For each task, the consumers must make a single choice. Across each task, the analyst changes the set of products, the levels of the characteristics and the prices in the choice set. This allows the analyst to observe how the consumer trades-off characteristics and prices. The data consist of the choices and the corresponding characteristics of the product alternatives from each task.
32. For instance, in one task, a consumer might be asked to choose between several different brands of daily moisturizing lotions, some of which have the ANC on the packaging and some of which do not. In a subsequent task, the consumer is asked again to make a choice between several different brands of daily moisturizing lotions, but the specific brands available might be changed along with the prices and the presence/absence of the ANC. These data create experimental, independent variation in the claim, the brand and the price.
33. The set of products included in the Conjoint Analysis is determined by the analyst. Therefore, it is possible to present the consumer with choice sets that include Aveeno-branded products without the ANC on the packaging. Consequently, Conjoint Analysis will be able to estimate the difference between a consumer's value from the Aveeno brand name and the value from ANC on the packaging.
34. The design of the conjoint survey and the collection of data involves several stages:
 - i) First the analyst determines which characteristics to include in the study. For a study of daily moisturizing lotions, the characteristics might consist of the brand

name (e.g. Aveeno), the package size (e.g. 12 fluid oz), and the presence/absence of the ANC on the packaging.

- ii) Second, the analyst determines which product configurations, or “profiles,” to include in the study. A profile consists of a permutation of the product characteristics and a price level. For instance, a daily moisturizing lotion product profile might consist of the Aveeno brand name, the 18 oz pack size, no “Active Naturals” claim on the packaging and a price of \$6.95. The set of profiles are chosen using experimental design methods. If the set of characteristics is small, a full-factorial design can be used which includes all possible permutations of the characteristics. Typically, the dimension of the characteristics is too large and a fractional-factorial design involving only a subset of the possible permutations is used instead. Feasibility restrictions can also be imposed on the selection of profiles.
- iii) Once the profiles have been determined, a subject pool is assembled to complete the surveys. The subject pool typically consists of a random sample of individuals who are representative of the consumer population of interest. Each subject is presented with a survey questionnaire consisting of a sequence of choice tasks. For each task, the subject is presented with a subset of the profiles and asked to choose one. Often, the no-purchase option is included as an alternative.
- iv) The conjoint data consist of each subject’s sequence of choices and the corresponding profiles from which the subject’s choices were made.

35. Once the conjoint data are ready, the estimation methodology proceeds as follows:

- i) Similar to RCDE, the method starts with the construction of a utility function that captures the value of the product as a function of observed covariates and parameters to be estimated (this includes the role of the ANC on the packaging).

- ii) Random Coefficients are included to allow the parameter vector to be heterogeneous across consumers. This heterogeneity is assumed to follow a Normal distribution with unknown parameters to be estimated.
- iii) All other factors influencing a consumer's total utility from a product that are not observed to the analyst are captured by a stochastic component, or "random utility" term. Typically, this component is assumed to be independently and identically distributed Type I Extreme Value.
- iv) Following the aforementioned steps one can then construct the probability of a purchase by integrating out all stochastic elements. The assumptions in steps (i)-(iii) give rise to the "Random Coefficients Logit" model.
- v) These predicted probabilities from the model are then used along with the data to construct a sample likelihood function that, in turn, forms the basis of a statistical estimator. The analyst could potentially use either a frequentist approach, like Simulated Maximum Likelihood, or a Bayesian approach, like Markov Chain Monte Carlo, to estimate the model parameters. See Appendix C.3 for a discussion of the two approaches.

36. The approach outlined in steps (i)-(v) above provides estimates of the model parameters. A formal derivation of the likelihood function corresponding to the choice model described above is presented in Appendix C.3. The interpretation of the model parameters is analogous to those obtained from the RCDE approach, in spite of the differences in the data and methodology used.

37. I have not seen any samples of the data for the product categories in which Aveeno uses the ANC. However, based on my knowledge of available data, I can implement the proposed methodology to determine how much consumers value products with "Active Naturals" placed on the label and how much more a consumer pays owing to the inclusion of "Active Naturals" on the label.

D. Counterfactuals and Damages Measures

38. The main goal from the estimation methods described in sub-sections B and C of section IV is to obtain estimates of consumers' marginal utilities for each of the relevant product characteristics, including price. In addition, the methods produce estimates of each firm's unit costs for their products. Once these quantities are measured, the analyst can compute the damages associated with the use of the ANC on Aveeno packaging. In particular, the analyst can compute (i) the equilibrium prices that would emerge but-for the ANC on Aveeno packaging; (ii) the consumer WTP associated with the ANC on Aveeno packaging. The methodologies for computing WTP and the change in equilibrium prices respectively are presented in Appendix C.5.

39. Therefore, calculating economic damages can be done in two ways using these methodologies:

- i) The WTP for the ANC on Aveeno packaging, assuming prices do not change.
- ii) The WTP for the ANC on Aveeno packaging, assuming prices adjust to the corresponding equilibrium values.

40. I have not yet seen any samples of data for the product categories in which Aveeno uses the ANC. Nor have I conducted a Conjoint Analysis. Therefore, I have yet to determine the incidence or magnitude of damages at this point. It is my understanding that the data necessary to conduct my analysis and damage calculation in this litigation are available. Such data will come from several sources: J&J's own business records; industry resources and independent market researchers (e.g., pricing, sales and product attribute information from IRI).

V. Reservation of Rights

41. I understand that discovery in this case is ongoing. I may amend or supplement my opinions to take into account facts developed in the discovery process.

I declare under the penalty of perjury that the foregoing is true and correct to the best of my knowledge, information, and belief. Executed in Chicago, Illinois, United States on September 17, 2015.



Jean-Pierre Dubé

Dated: September 17, 2015.

Appendix A

Jean-Pierre Dubé Curriculum Vitae

ADDRESS

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ACADEMIC APPOINTMENTS

- September 2008 – , Sigmund E. Edelstone Professor of Marketing, The University of Chicago Booth School of Business, Chicago, IL 60637
- July 2006 – August 2008, Professor of Marketing and Neubauer Family Faculty Fellow, Graduate School of Business, University of Chicago, Chicago, IL 60637
- November 2003 – July 2006, Associate Professor of Marketing, Graduate School of Business, University of Chicago, Chicago, IL 60637
- April 2000 – November 2003, Assistant Professor of Marketing, Graduate School of Business, University of Chicago, Chicago, IL 60637

AFFILIATIONS

- September 2013 - , Director, Kilts Center for Marketing, The University of Chicago Booth School of Business
- April 2009 – , Faculty Research Fellow, *National Bureau of Economic Research*, Industrial Organization
- 2008-2010, Affiliate, Yahoo! Microeconomics Research Group.

EDUCATION

- 1995-2000, Northwestern University, Evanston, Illinois, Doctor of Philosophy (Economics)
- 1995-1996, Northwestern University, Evanston, Illinois, Master of Arts (Economics)
- 1991-1995, University of Toronto, Toronto, Canada, H.B.Sc. (Quantitative Methods in Economics)

REFERRED PUBLICATIONS

1. "Market Structure Across Stores: an application of a random coefficients model with store level data," with Pradeep Chintagunta and Vishal Singh, *Advances in Econometrics: Econometric Models in Marketing*, ed. Philip Hans Franses and Alan Montgomery (JAI Press: 2002).
2. "[Structural Applications of the Discrete Choice Model](#)," (1st author) with Pradeep Chintagunta, Bart Bronnenberg, Ron Goettler, Amil Petrin, P.B. Seetheraman, K. Sudhir, Raphael Thomadsen and Ying Zhao, *Marketing Letters*, 13 (3), 207-220, 2002.
3. "[Balancing profitability and customer welfare in a supermarket chain](#)," with Pradeep Chintagunta and Vishal Singh, *Quantitative Marketing and Economics*, Inaugural Issue, 1 (1), 2003.

4. "Competitive Price Discrimination Strategies in a Vertical Channel with Aggregate Data," with David Besanko and Sachin Gupta, *Management Science*, 49 (9), 2003
 - **Finalist, 2004 John D.C. Little Award**
5. "[Discussion of 'Bayesian Analysis of Simultaneous Demand and Supply'](#)," *Quantitative Marketing and Economics*, 1 (3), 2003.
6. "[Multiple Discreteness and Product Differentiation: Demand for Carbonated Soft Drinks](#)," *Marketing Science*, 23 (1), 2004.
 - **Finalist, 2005 John D.C. Little Award**
 - **Finalist, 2006 Frank M. Bass Outstanding Dissertation Award**
 - **Finalist, 2014 Long-Term Impact Award**
7. "[Empirical Analysis of Indirect Network Effects in the Market for Personal Digital Assistants](#)," with Harikesh Nair and Pradeep Chintagunta, *Quantitative Marketing and Economics*, 2 (1), 23-58, 2004.
 - **Finalist, 2005 AMA TechSIG Best Article Award**
8. "[Retail Pass-Through on Competing Brands](#)," with David Besanko and Sachin Gupta, *Marketing Science*, 24 (1), 2005.
9. "[Dynamic Brand Competition Across Markets: an empirical analysis](#)," with Puneet Manchanda, *Marketing Science*, 24(1), 2005.
10. "Beyond the endogeneity bias: the effect of unmeasured brand characteristics on household-level brand choice models," with Pradeep Chintagunta and Kim Yong Goh, *Management Science*, 51 (2), 2005.
 - formerly titled "Targeted Pricing and the estimation of consumer choice models in the presence of unmeasured product characteristics"
11. "Product Differentiation and Mergers in the Carbonated Soft Drink Industry," *Journal of Economics and Management Strategy*, 14 (4), 2005.
12. "Recent advances in structural econometric modeling: dynamics, product positioning and entry," with K. Sudhir, Andrew Ching, Greg Crawford, Michaela Draganska, Jeremy T. Fox, Wesley Hartmann, Gunter Hitsch, V. Brian Viard, Miguel Villas-Boas, Nauffel Vilcassim, *Marketing Letters*, 16(3), 2005.
13. "Estimating an SKU-level Brand Choice Model Combining Household Panel Data and Store Data," with Pradeep Chintagunta, forthcoming at the *Journal of Marketing Research*, XLII (3), 2005.
14. "[Accounting for Primary and Secondary Demand Effects with Aggregate Data](#)," with Harikesh Nair and Pradeep Chintagunta, *Marketing Science*, 24(3), 2005.
 - formerly titled "Discrete/Continuous Demand Estimation with aggregate data: formulation and empirical application"
15. "[An Empirical Model of Advertising Dynamics](#)," with Günter Hitsch and Puneet Manchanda, *Quantitative Marketing and Economics*, 3(2), 2005.
16. "The Effect of Banner Advertising on Internet Purchasing," with Puneet Manchanda, Kim Yong Goh and Pradeep Chintagunta, *Journal of Marketing Research*, XLIII (1), February 2006.
17. "Consumer Packaged Goods in the United States: National Brands, Local Branding," with Bart Bronnenberg and Sanjay Dhar, *Journal of Marketing Research*, XLIV (1), February 2007 (lead article).
 - **Winner, 2008 Paul E. Green Award of the American Marketing Association**
 - **Finalist, 2012 William O'Dell Award of the American Marketing Association**
 - *Also follow-up comment: "National Brands, Local Branding: Conclusions and Future Directions"*
18. "Prominence Effect in Shanghai Apartment Prices," with Chris Hsee and Yan Zhang, *Journal of Marketing Research*, XLV (2), April 2008(lead article).
 - formerly titled "A Behavioral Analysis of the Shanghai Real Estate Market"

19. "Category Pricing with State Dependent Utility," with Günter Hitsch, Peter Rossi and Maria Ana Vitorino, *Marketing Science*, May/June 2008.
 - **Finalist, 2008 John D.C. Little Award**
20. "Cross-Brand Pass-through in Supermarket Pricing," with Sachin Gupta, *Marketing Science*, May/June 2008(lead article).
21. "Measuring Long Run Marketing Effects and their Implications for Long Run Marketing Decisions," with Bart Bronnenberg, Carl Mela et al., *Marketing Letters*, 19(3), 2008.
22. "Brand History, Geography, and the Persistence of Brand Shares," with Bart Bronnenberg and Sanjay Dhar, *Journal of Political Economy*, February 2009, 117(1).
 - formerly titled "Market Structure and the Geographic Distribution of Brand Shares in CPG Industries"
23. "Do Switching Costs Make Markets Less Competitive?" with Günter Hitsch and Peter Rossi, *Journal of Marketing Research*, XLVI(4), August 2009 (lead article).
 - **Finalist, 2013 William O'Dell Award of the American Marketing Association**
24. "Rejoinder to Cabral (2009) and Shin and Sudhir (2009)," with Günter Hitsch and Peter Rossi, *Journal of Marketing Research*, XLVI(4), August 2009.
25. "Tipping and Concentration in Markets with Indirect Network Effects," with Günter Hitsch and Pradeep Chintagunta, *Marketing Science*, March/April 2010.
 - **Finalist, 2010 John D.C. Little Award**
26. "State Dependence and Alternative Explanations for Consumer Inertia," with Günter Hitsch and Peter Rossi, *RAND Journal of Economics*, 41(3), Autumn 2010 (lead article).
27. "Do DVRs Influence Consumers' Brand Purchases?" with Bart Bronnenberg and Carl Mela, *Journal of Marketing Research*, 47(6), December 2010.
28. "Endogenous Sunk Costs and the Geographic Differences in the Market Structures of CPG Categories," with Bart Bronnenberg and Sanjay Dhar, *Quantitative Marketing and Economics*, 9(1), March 2011.
29. "The Evolution of Brand Preferences: Evidence from Consumer Migration", with Bart Bronnenberg and Matt Gentzkow, *American Economic Review*, 102(6), October 2012.
30. "Improving the Numerical Performance of BLP Static and Dynamic Discrete Choice Random Coefficients Demand Estimation," with Jeremy Fox and Che-Lin Su, *Econometrica*, 80(5), September 2012.
 - [Computer Code to estimate the Random Coefficients Logit via GMM using the MPEC algorithm](#)
31. "The Joint Identification of Utility and Discount Functions From Stated Choice Data: An Application to Durable Goods Adoption," with Günter Hitsch and Pranav Jindal, *Quantitative Marketing and Economics*, 12, 2014.
32. "Do Pharmacists Buy Bayer? Sophisticated Shoppers and the Brand Premium," with Bart Bronnenberg, Matt Gentzkow and Jesse Shapiro, *Quarterly Journal of Economics*, 130(4).

WORKING PAPERS

1. Self-Signaling and Pro-Social Behavior: a cause marketing mobile field experiment, with Xueming Luo and Zheng Fang
2. "Income and Wealth Effects on Private Label Demand: Evidence From the Great Recession," with Guenter Hitsch and Peter Rossi.

WORKS IN PROGRESS

1. Information and Private Label Demand: an in-store field experiment, with Bart Bronnenberg and Robert Sanders

2. Competitive Price Targeting: a mobile field experiment, with Xueming Luo, Nathan Fong and Zheng Fang
3. The Geography of Poverty and Nutrition: Causes and Consequences of Food Deserts, with Hunt Alcott and Rebecca Diamond
4. Weather, Mood and Demand, with Xueming Luo
5. Online sentiment and demand, with Chris Nosko and Matt Taddy
6. Initial Conditions and Structural State Dependence, with Guenter Hitsch, Peter Rossi and Andrey Simonov

ACADEMIC PRESENTATIONS

"Income and Wealth Effects on Private Label Demand: Evidence From the Great Recession"

- *European Commission, June 2015*

"Self-Signaling and Pro-Social Behavior: a cause marketing mobile field experiment"

- *University of Alberta, May 2015*
- *Columbia University, Columbia GSB, May 2015*
- *NBER winter I.O. meetings, Feb 2015*
- *Winter Marketing-Economics Summit, Jan 2015*
- *Washington University, Olin School of Business, January 2015*
- *University of Pennsylvania, Wharton School of Business, January 2015*
- *Temple University, Fox School of Business, January 2015*
- *University of Chicago (Economics), November 2014*
- *Princeton, November 2014*
- *University of Wisconsin (economics), November 2014*
- *University of Chicago, Booth School of Business, October 2014*
- *University of Houston, October 2014*
- *Universiteit van Tilburg, September 2014*
- *HEC Paris, August 2014*
- *Colloquium on Big Data and Mobile Analytics, Temple University, November 2013*

"Persistence in Market Structure and Brand Preferences for CPG"

- *ICT, University of Porto, March 2014*

"Do Pharmacists Buy Bayer? Sophisticated Shoppers and the Brand Premium"

- *Marketing Insights at Chicago Booth, May 2014*
- *Winter Marketing-Economics Summit, Jan 2014*
- *Simon School of Business, University of Rochester, October 2013*
- *Fudan University, September 2013*
- *SITE, July 2013.*
- *MIT (economics), April 2013.*
- *The University of British Columbia, Sauder School of Business, March 2013*
- *University of Colorado Boulder, Leeds School of Business, February 2013*
- *University of Zurich, January 2013*
- *Stern School, NYU, September 2012*
- *Cheung Kong University, June 2012*
- *Consumer Insights Conference, Yale University, May 2012*
- *Santa Clara University, January 2012*
- *University of Urbana-Champaign (economics), October 2011*
- *The Kelley School of Business, Indiana University, September 2011*
- *The 4th Workshop on the Economics of Advertising and Marketing (discussant Alexander Stepanov), Moscow, June 2011*

"The Evolution of Brand Preferences: Evidence from Consumer Migration"

- Formerly Titled "Migration and the Persistence of Consumer Brand Preferences"
 - *University of Western Ontario (economics), October 2010*
 - *Boston College, September 2010*
 - *NBER, summer I.O. meetings (discussant Fiona Scott Morton), July 2010*
 - *Marketing Camp, UCLA, May 2010*
 - *Consumer Insights Conference, Yale University, May 2010*
 - *MI9 Conference, University of Tel Aviv, December 2009*
 - *Marketing Camp, HKUST, December 2009*
 - *The 2nd Workshop on the Economics of Advertising and Marketing (discussant Sara Biancini), Paris, June 2009*

"Estimating Durable Goods Adoption Decisions From Stated Preference Data"

- *UC Davis, March 2011*
- *The 2011 UTD Frank Bass Forms Conference, February 2011*
- *London Business School, January 2011*
- *The 2010 Choice Symposium (hosted by University of Miami), May 2010*
- *Marketing Dynamics Conference, NYU, August 2009*

"Dynamic Decision Problems in Marketing"

- *Marketing Dynamics Conference, University of Waikato, January 2009*

"Improving the Numerical Performance of Discrete Choice Random Coefficients Demand Estimation,"

- *NBER, winter I.O. meetings (discussant Steve Berry), February 2009*
- *Federal Trade Commission, November 2008*
- *Northwestern University (economics), October 2008*
- *University of Rochester, October 2008*

"Tipping and Concentration in Markets with Indirect Network Effects"

Formerly Titled "Dynamic Standards Competition and Tipping: the case of 32/64 bit video game consoles"

- *CRA International, July 2008*
- *University of Connecticut (Food Marketing), April 2008*
- *Yale University (economics), April 2008*
- *NBER, winter I.O. meetings (discussant Dan Ackerberg), February 2008*
- *Wharton, February 2008*
- *Fuqua School, Duke University, January 2008*
- *Universiteit van Tilburg, January 2008*
- *The 2007 Choice Symposium (hosted by Wharton), June 2007*

"Do Switching Costs Make Markets Less Competitive?"

- *Yahoo! Inc., October 2007*
- *The Canadian Competition Bureau, September 2007*
- *2007 UBC Summer Conference on Industrial Organization, July 2007*
- *University of British Columbia, February 2007*
- *Universiteit van Tilburg, January 2007*
- *Inflation Research Center (discussant Alex Wolman), Chicago Fed, December 2006*
- *Stern School, NYU, December 2006*
- *HEC Montreal, December 2006*
- *University of Minnesota (economics), September 2006*

- *NBER, summer I.O. meetings (discussant Alan Sorensen), July 2006*
- *Erasmus University Rotterdam, June 2006*
- *Yale SOM, April 2006*

"Category Pricing with State Dependent Utility"

Formerly titled "State Dependence in Demand and Long-Run Pricing"

- *Marketing Science, Pittsburgh, June 2006*
- *Kellogg Marketing Camp, Northwestern University, September 2005*

"Endogenous Sunk Costs and the Geographic Distribution of Brand Shares in CPG Industries"

- *Strategic and Tactical Decision Making in Supermarket Retailing, SUNY Buffalo, August 2005*
- *Summer Institute for Competitive Strategy (discussant Avi Goldfarb), Berkeley, June 2005*
- *CRES I.O. conference (discussant Emek Baskar), Olin School, June 2005*
- *Northwestern/Chicago I.O. and Marketing Conference, June 2005*
- *Duke (economics), April 2005*
- *Harvard/MIT (economics), February 2005*
- *NBER, winter I.O. meetings (discussant Jonathan Levin), February 2005*
- *Winter Marketing Camp at Leuven, December 2004*
- *Johnson School, Cornell University, December 2004*

"An Empirical Model of Advertising Dynamics"

- *University of Arizona (economics), November 2004*
- *Federal Trade Commission, October 2004*
- *Stern School, NYU, June 2004*
- *London Business School, May 2004*
- *Haas School, UC Berkeley, April 2004*
- *Winter Marketing Camp at Leuven, December 2003*
- *Columbia GSB, Columbia University, November 2003*
- *Joint workshop – University of Waterloo, Wilfrid Laurier University and CIGI, October 2003*
- *Department of Justice, October 2003*

"Estimating an SKU-level Brand Choice Model Combining Household Panel Data and Store Data"

- *Marketing Science, University of Maryland, June 2003.*

"Targeted Pricing and the estimation of consumer choice models in the presence of unmeasured product characteristics"

- *Rotman School of Management, University of Toronto, April 2003*
- *Columbia GSB (economics), Columbia University, April 2003*
- *GSIA, Carnegie Mellon University, April 2003*
- *Insead, December 2002*
- *Winter Marketing Camp at Leuven, December 2002*
- *Wharton, December 2002*
- *University of Chicago GSB, October 2002*
- *INFORMS conference on pricing, Cornell, September 2002*

"Balancing profitability and customer welfare: an application to zone pricing by a supermarket chain"

- *Universidade Nova de Lisboa (economics), June 2002*

- *Anderson School, UCLA, April 2002*
- *Sloan School, MIT, September 2001*
- *Marketing Science, Wiesbaden, July 2001*
- *The 2001 Choice Symposium (hosted by UC Berkeley), Monterey CA, June 2001*

"Competitive Price Discrimination Strategies in a Vertical Channel with Aggregate Data"

- *Stanford GSB, April 2002*
- *INFORMS, San Antonio, November 2000*
- *Marketing Science, UCLA, June 2000*

"Dynamic Brand Competition Across Markets: an empirical analysis"

- *Marketing Science, Wiesbaden, July 2001*
- *MSI Conference on Competitive Response, May 2001*

"Product Differentiation and Mergers in the Carbonated Soft Drink Industry"

- *University of Chicago GSB (economics), January 2001*
- *Econometric Society Meetings, University of Washington, Seattle, August 2000*
- *Northwestern University (economics), October 1999*

"Multiple Discreteness and Product Differentiation: Strategy and Demand for Carbonated Soft Drinks"

- *Johnson School, Cornell University, April 2001*
- *Kellogg GSM, Northwestern University, December 1999*
- *Haas School, UC Berkeley, November 1999*
- *University of Chicago GSB, November 1999*
- *Simon School, University of Rochester, November 1999*
- *Olin School, Washington University, October 1999*
- *Yale SOM, October 1999*
- *Rotman School of Management, University of Toronto, October 1999*

PAID SPEAKING ENGAGEMENTS

- CEO Perspectives, Chicago, May 2015
- Marketing Strategy Group, Chicago, April 2015
- Global Leadership Series, Chicago Booth, Jakarta, June 2014
- National University of Singapore, June 2014
- McDonalds, April 2014, July 2014
- Colloquium on Big Data and Mobile Analytics, November 2013
- Phoenix Products Company, Inc., November 2012
- Cheung Kong University, Trends in Marketing, June 2012
- CCIM Institute, September 2011
- ThermoFischer, September 2011
- Marketing Leadership Forum at Baxter, April 2011
- Charles River Annual Sales Meeting, January 2009
- American Bar Association, January 2009
- The Marketing Leadership Council, December 2008
- Kraft Brand Management Forum, July 2008
- NAVTEQ Global Sales and Marketing Meeting, January 2007

CONSULTING

- American Bar Association
- Australian Government Solicitors

- Charles River Associates
- CCIM Institute
- The European Commission (design of software for merger analysis and pricing)
- Morris, Manning & Martin, LLP
- Pattishal McAuliffe
- Qualcomm
- The Roundtable Group
- The Scotts Company
- Winthrop and Weinstine
- Yahoo! Research

EXECUTIVE TEACHING

- CEO Middle Market Forum
- CIO Forum
- Directors' Consortium
- General Management Program: Marketing Analytics, Kuwait
- McDonald's Corp.
- Strategic Marketing Management, Chicago Booth School of Business
- Roundy's
- RSM McGladrey
- Tomra Systems
- UOP LLP (A Honeywell Company)
- Workiva
- Zimmer, Inc.

COURSES TAUGHT

- Marketing Strategies for High Technology and the Internet (BUS 37302)
- Pricing Strategies (BUS 37202, BUS 37801 – Executive MBA, SMM – non-degree)
- Advanced Quantitative Marketing (BUS 37904)
- Big Data and Marketing Analytics (executive)
- Category Management (executive)

OTHER

Associate/Area Editor:

- *Journal of Marketing Research*
- *Marketing Science*
- *Management Science*
- *Quantitative Marketing and Economics*

Member, Editorial Board

- *Production and Operations Management*, 2003-2007
- *Recherche et Applications en Marketing (RAM)*, 2004-2008

Ad hoc Reviewer:

The American Economic Review, Econometrica, The Economic Journal, International Journal of the Economics of Business, International Journal of Research in Marketing, Journal of Business and Economic Statistics, Journal of Consumer Research, Journal of Industrial Economics, Journal of Law, Economics and Organizations, Journal of Political Economy,

Journal of Retailing and Consumer Services, NBER, NSF, The Quarterly Journal of Economics, The Rand Journal of Economics, The Social Sciences and Humanities Research Council of Canada.

Awards

- 2008, Paul E. Green from the American Marketing Association
- *Faculty Teaching Excellence Award*, Evening and Weekend MBA Programs, University of Chicago GSB, 2005

Appointments and Grants

- MSI Research Grant #4-1765, 2012
- Grant from the IGM, University of Chicago, 2011
- MSI Research Grant #4-1667, 2010
- Robert King Steel Faculty Fellow, 2009-2010, 2010-2011, 2011-2012
- Beatrice Foods, Co. Scholar, 2009-2010
- Grant from the IGM, University of Chicago, 2009
- Yahoo! Faculty Research Grant, 2008
- MSI Research Grant #4-1525, 2008
- Grant from the IGM, University of Chicago, 2007
- MSI Research Grant #4-1450, 2007
- Grant from the Polsky Center for Entrepreneurship, 2007
- ACG Research Fellow, 2006-2007
- Beatrice Foods, Co. Scholar, 2005-2006.
- MSI Research Grant # 4-1301, 2005
- True North Communications, Inc. Scholar, 2003-2004.
- Beatrice Foods, Co. Scholar, 2001-2002.

Advisory Board

- Comscore Networks
- Prepme.com
- Global Center for Big Data in Mobile Analytics
- INFORMS Society for Marketing Science (ISMS)

Member

- AEA
- INFORMS

Doctoral Dissertation Committees

- Indranil Goswani (expected 2016)
- Yufeng Huang (expected 2015)
- Avigail Kifer (expected 2015)
- Dan Nguyen (expected 2015)
- Dan Zou (expected 2015)
- Pranav Jindal, 2012 (Penn State)
- Navdeep Sahni, 2012 (Stanford)
- Elisabeth Honka, 2010 (UT Dallas)
- Renna Jiang, 2009 (UC Davis)
- Mitsukuni Nishida, 2009 (National University of Singapore)
- Maria Ana Vitorino, 2008 (Wharton)

- Felipe Diniz, 2008 (McKinsey)
- Hongju Liu, 2007 (University of Connecticut)
- Junhong Chu, 2006 (Business School , National University of Singapore)
- Minhua Wan, 2006 (UT Dallas)
- Harikesh Nair, 2005 (GSB, Stanford University)
- Khim Yong Goh, 2005 (Singapore National University)
- Guillermo Israilevich, 2003 (Bates White, LLC)
- Inseong Song, 2002 (Hong Kong University of Science and Technology)
- Vishal Singh, 2002 (Carnegie Mellon GSIA)

Appendix B
Documents on which I have relied

Case No. 11-cv-05465 CAS (JCX) consolidated with CV11-01067 CAS (JCX), DECLARATION OF SANJOG MISRA, PH.D., IN SUPPORT OF PLAINTIFF'S RENEWED MOTION TO CERTIFY THE CALIFORNIA CLASS

Case No. 7:13-cv-03073-NSR-LMS, SECOND AMENDED CLASS ACTION COMPLAINT

Appendix C

C.1 The Characteristics Approach and the Utility Function

First define the following notation. Let $h=1,\dots,H$ index the consumers in a market. Let $j=1,\dots,J$ index the products available in a market. Let X_j denote the $(K \times 1)$ vector of characteristics of product alternative j . Let p_j denote the price of product j .

Assume that each consumer can only choose one single alternative. Consumer h obtains the following utility when she chooses product j :

$$u_j^h = X_j' \beta^h - \alpha^h p_j + \epsilon_j^h$$

where ϵ_j^h is the component of consumer h 's utility that is not observed to the analyst. β is a $(K \times 1)$ vector of marginal utilities for each of the respective characteristics. α is a consumer's price sensitivity, capturing the opportunity cost of her money given that she could have decided not to buy a product and use the money for other purposes. We can collectively refer to a consumer's *tastes* as: $\theta^h = (\beta^h, \alpha^h)$. Let $j=0$ denote the no-purchase choice and let $u_0^h = \epsilon_0^h$ denote the utility from not purchasing anything.

Following the convention in the literature (e.g. Berry, Levinson and Pakes 1995, and Nevo 2000), we assume that ϵ_j^h is independently and identically distributed Type I Extreme Value across households and product alternatives. If a consumer always chooses the alternative that gives her the highest utility, then it is straightforward to show that the probability that she chooses product j is:

$$Prob(j|X; \theta^h) = \frac{\exp(X_j' \beta^h - \alpha^h p_j)}{1 + \sum_{i=1}^J \exp(X_i' \beta^h - \alpha^h p_i)}. \quad (1)$$

Equation (1) is the standard conditional logit choice probability.

In practice, the analyst does not know each consumer's *tastes*, $\{\theta^h\}_{h=1}^H$. If we assume that the population distribution of marginal utilities is Normal, then $\theta^h \sim N(\bar{\theta}, \Sigma)$ where $\bar{\theta}$ and Σ are the mean and covariance matrix respectively. The unconditional probability that consumer h chooses product j is:

$$Prob(j|X; \bar{\theta}, \Sigma) = \int \frac{\exp(X_j' \beta - \alpha^h p_j)}{1 + \sum_{i=1}^J \exp(X_i' \beta - \alpha^h p_i)} d\Phi(\bar{\theta}, \Sigma) \quad (2)$$

where $\Phi(\bar{\theta}, \Sigma)$ is the cumulative density function of a Normal distribution with mean $\bar{\theta}$ and covariance matrix Σ . Equation (2) is the standard random coefficients logit choice probability.

C.2 Estimation of the Random Coefficients Logit using Aggregate Market Share Data or *Random Coefficients Demand Estimation (RCDE)*

Suppose that the data available to the researcher consist of $t=1,\dots,T$ independent markets. In each market, the analyst observes each product's market share:

$$S_{jt} = \frac{Q_{jt}}{M_t} \quad (3)$$

where Q_{jt} is the number of units of product j sold in market t (i.e. number of consumers who choose alternative j), and M_t is the total number of consumers (i.e. total number of potential units sold) in market t . In addition, the analyst observes each product's characteristics, X_{jt} , which includes each product's respective price.

At the aggregate level, it is customary to include an additional macro-economic “shock” to each product's utility, ξ_{jt} , which could be interpreted as the effect of unobserved (to the analyst) product characteristics on choices. We can now re-write the unconditional probability that a consumer chooses product alternative j in market t (i.e. its market share) by modifying equation (2) as follows:

$$s(j|X_t, \xi_t; \bar{\theta}, \Sigma) = \int \frac{\exp(X'_{jt}\beta - \alpha^h p_j + \xi_{jt})}{1 + \sum_{i=1}^J \exp(X'_{it}\beta - \alpha^h p_i + \xi_{it})} d\Phi(\bar{\theta}, \Sigma) \quad (3)$$

where X_t is a $(K \times J)$ matrix of all products' characteristics and ξ_t is a $(J \times 1)$ vector of all the unobserved characteristics.

In this setting, the analyst's empirical objective consists of estimating the unknown parameters, $\Theta = (\bar{\theta}, \Sigma)$. Once these parameters are known, it is possible to predict how changes in product characteristics or prices, X_{jt} , would change product j 's market share. For instance, suppose we change product j 's characteristics from X_{jt} to \tilde{X}_{jt} , holding all else constant in the market. The analyst would then predict that the market share for product j would change from $s(j|X_t, \xi_t; \Theta)$ to $s(j|\tilde{X}_t, \xi_t; \Theta)$.

A GMM estimator of the model parameters can be constructed as follows. Berry (1994) shows that the unobserved product characteristics can be inverted out of the observed market shares using the model in equation (3): $\xi_t(\Theta) = s^{-1}(S_t; \Theta)$. Suppose the analyst has a set of instruments, Z_{jt} , such that $E(\xi_{jt}|Z_{jt}) = 0$. Then the analyst can construct the following moment conditions:

$$g(\xi(\Theta)) = \frac{1}{T} \sum_{t=1}^T \sum_{j=1}^J \xi_{jt}(\Theta) Z_{jt}. \quad (4)$$

A GMM estimator can then be constructed using the empirical analog of the moment conditions in (4):

$$\boldsymbol{\theta}^{GMM} = \operatorname{argmax}_{\boldsymbol{\theta}} g(\boldsymbol{\xi}(\boldsymbol{\theta}))' \mathbf{W} g(\boldsymbol{\xi}(\boldsymbol{\theta})) \quad (5)$$

where \mathbf{W} is a weighting matrix. See Dubé, Fox and Su (2012) for a discussion of different algorithms that can be used to obtain the GMM estimate in (5).

C.3 Estimating the Product Unit Costs

Index each of the competing firms in the product category being analyzed by $f=1,\dots,F$. Assume that each firm produces products $k \in \Omega_f$. Each product k has a constant unit cost c_k . A firm f earns total profits:

$$\pi(\mathbf{p}_f | \mathbf{p}_{-f}) = \sum_{k \in \Omega_f} (p_k - c_k) s(k | X, \xi; \bar{\theta}, \Sigma) \quad (6)$$

where \mathbf{p}_f is firm's f 's vector of prices and \mathbf{p}_{-f} is the vector of all the prices of the products managed by all the other firms.

If the analyst assumes that each firm sets its prices to maximizes its profitability, the Bertrand-Nash equilibrium prices are characterized by the following first-order necessary conditions:

$$s(j | X, \xi; \bar{\theta}, \Sigma) + \sum_{\{k | j, k \in \Omega_f\}} (p_k - c_k) \frac{\partial s(k | X, \xi; \bar{\theta}, \Sigma)}{\partial p_j} = 0. \quad (7)$$

The prices, p_k , are observed in the data. After completing RCDE, it is possible to predict $s(j | X, \xi; \bar{\theta}, \Sigma)$. Therefore, the analyst can use the first-order necessary conditions above to infer each product's unit cost.

C.4 Estimation of the Random Coefficients Logit using Conjoint Analysis

Suppose that the data available to the researcher consist of $h=1,\dots,H$ consumers who each make $t=1,\dots,T$ independent choices. For each choice task, the analyst observes the characteristics, X_{jt} , of each of the $j = 1, \dots, J_t$ product alternatives. The analyst also observes which product a consumer chose in each task:

$$y_{jt} = \begin{cases} 1, & j \text{ chosen on task } t \\ 0, & \text{else} \end{cases} \quad (8)$$

For a given consumer h , the conditional likelihood of observing her sequence of choices is given by:

$$\mathfrak{L}(Y_h|X_h; \theta^h) = \prod_t \prod_j \text{Prob}(j|X_t; \theta^h) \quad (9)$$

where the probabilities are given by equation (1).

Estimation of the model parameters can be conducted using either simulated maximum likelihood or MCMC. A simulated maximum likelihood estimate would be obtained as follows:

$$\Theta^* = \underset{\Theta}{\text{argmax}} \prod_h \int \mathfrak{L}(Y_h|X_h; \theta) d\Phi(\bar{\theta}, \Sigma). \quad (10)$$

An MCMC estimate would be obtained by drawing from the following Hierarchical model:

$$\mathfrak{L}(Y_h|X_h; \theta^h) \quad (11i)$$

$$\theta^h \sim N(\bar{\theta}, \Sigma) \quad (11ii)$$

$$\bar{\theta} \sim N(\bar{\bar{\theta}}, A^{-1}) \quad (11iii)$$

$$\Sigma \sim IW(\nu, V) \quad (11iv)$$

where $\bar{\bar{\theta}}, A, \nu$ and V are prior parameters that need to be set by the researcher. Details on how to draw a Markov chain with which to estimate the model parameters are available in Rossi, Allenby and McCulloch (2005).

C.5 Counterfactual Measurement

Suppose the analyst has estimated the demand parameters, Θ , and the product unit costs, (c_1, \dots, c_J) . The analyst can compute the expected dollar value per consumer when \mathbf{X} is the set of available product characteristics and \mathbf{p} is the vector of prices charged as follows:

$$Value(\mathbf{X}, \mathbf{p}; \Theta) = \int \frac{\ln(1 + \sum_j \exp(x_j \beta - \alpha p_j))}{\alpha} d\Phi(\bar{\theta}, \Sigma). \quad (12)$$

The equilibrium prices, \mathbf{p} , that would prevail when \mathbf{X} is the set of available product characteristics and (c_1, \dots, c_J) are the product unit costs can be computed by solving the following system:

$$s(j|\mathbf{X}; \bar{\theta}, \Sigma) + \sum_{\{k|j, k \in \Omega_f\}} (p_k - c_k) \frac{\partial s(k|\mathbf{X}; \bar{\theta}, \Sigma)}{\partial p_j} = 0 \quad (13)$$

where $s(j|\mathbf{X}; \bar{\theta}, \Sigma)$ is the predicted market share from the model, as before.

The analyst can now evaluate how the market outcomes would change under the counterfactual scenario where the market characteristics are changed from \mathbf{X} to $\tilde{\mathbf{X}}$. For instance, suppose each row of \mathbf{X} corresponding to an Aveeno-branded product has the “Active Naturals” claim removed.

The expected WTP per customer for the “Active Naturals” claim, holding prices fixed at their observed levels, \mathbf{p} , is computed as follows:

$$WTP^{ANC} = Value(\mathbf{X}, \mathbf{p}; \Theta) - Value(\tilde{\mathbf{X}}, \mathbf{p}; \Theta). \quad (14)$$

The expected WTP per customer for the “Active Naturals” claim, after allowing prices to adjust to their counterfactual equilibrium levels, $\tilde{\mathbf{p}}$, is computed as follows:

$$WTP_{\Delta p}^{ANC} = Value(\mathbf{X}, \mathbf{p}; \Theta) - Value(\tilde{\mathbf{X}}, \tilde{\mathbf{p}}; \Theta). \quad (15)$$

Finally, the change in the average revenue per unit sold of a given Aveeno product k after the “Active Naturals” claim is removed from the packaging is given by:

$$\Delta Rev_k = \tilde{p}_k - p_k. \quad (16)$$

References

Allenby, G. and J. Brazzell and J. Howell (2014): “Economic Valuation of Product Features,” *Quantitative Marketing and Economics*, Vol. 12, no. 4, 421-456.

Berry, S. (1994): “Estimating Discrete-Choice Models of Product Differentiation,” *Rand Journal of Economics*, Vol. 25, No. 2, 242-262.

Berry, S., J. Levinsohn, and A. Pakes (1995): “Automobile Prices in Market Equilibrium,” *Econometrica*, Vol. 63, No. 4, 841–890.

Dubé, J.-P., J. T. Fox, and C.-L. Su (2012), “Improving The Numerical Performance Of Static And Dynamic Aggregate Discrete Choice Random Coefficients Demand Estimation,” *Econometrica*, Vol. 80, No. 5, 2231-2267.

Green, P.E. and V. Srinivasan (1990), “Conjoint Analysis in Marketing: New Developments with Implications for Research and Practice,” *Journal of Marketing*, Vol. 54, October 1990, 3-19.

Nevo, A. (2000), “A Practitioner’s Guide to Estimation of Random-Coefficients Logit Models of Demand,” *Journal of Economics & Management Strategy*, Vol. 9, No. 4, 513–548.

Rossi, P. E., G. M. Allenby and R. McCulloch (2005), *Bayesian Statistics and Marketing*, New York: John Wiley and Sons.